Air Quality Monitoring

Girouxville Confined Feeding Operations

November 29, 30 and December 1 2004 *Interim Report*

Summary

Alberta Environment conducts mobile air quality surveys each year as part of its air quality monitoring program in Alberta. These monitoring surveys are unannounced and use the Department's *Mobile Air Monitoring Laboratory* (MAML). The MAML monitoring provides a "snapshot" in time and space of the air quality at the location monitored. Pollutants measured by the MAML included carbon monoxide, oxides of nitrogen, ozone, particulate matter, hydrocarbons, sulphur dioxide, hydrogen sulphide, total reduced sulphur and ammonia.

A number of odour complaints have been filed with the Natural Resources Conservation Board (NRCB), the Municipal District of Smoky River No. 130, the Peace Health Region and Alberta Environment (AENV) regarding confined feeding operations (CFOs) south of Girouxville, Alberta. A public interest group known as FOUL (Friends Of an Unpolluted Lifestyle) submitted a request for air monitoring near a group of hog barns operated by Smoky Pork Limited and Venture Agri-Corp.

Alberta Environment has responded to FOUL's request and is currently conducting a mobile ambient air quality monitoring survey south of Girouxville. The study is ongoing and will consist of at least two surveys over two seasons. The results reported here are from the Fall 2004 survey. A total of 17 hours of data were collected over 3 sampling days at 7 locations when the MAML was deployed on November 29, 30 and December 1 2004. Each site was monitored for a minimum of one hour to allow comparison with applicable Alberta one-hour Ambient Air Quality Objectives (AAAQO).

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Monitoring sites were selected to provide air quality data both near homesteads and near CFOs. No exceedances of the hourly AAAQOs were recorded during this first phase of monitoring. However, short-term elevated concentrations of certain compounds near the fence line of the CFOs may be perceptible to odour sensitive individuals. No short-term elevated concentrations were recorded near residential locations.

The MAML is scheduled to return to the area to complete a second season of data collection in the Spring or Summer of 2005. After the second season of monitoring is complete, a formal report will be published. At the request of FOUL, Alberta Environment is providing this interim document; the final report will include Alberta Environment's conclusions and recommendations.

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Preliminary Findings Discussion

1) **Overview:** Concentrations of the air pollutants monitored near Girouxville confined feeding operations (CFOs) were below Alberta's Ambient Air Quality Objectives.

Alberta has one-hour air quality objectives for ammonia, carbon monoxide, hydrogen sulphide, nitrogen dioxide, ozone, and sulphur dioxide. Table 1 summarizes the preliminary monitoring results and compares them to applicable objectives; maximum one-hour concentrations for pollutants with 1-hour objectives were:

- 11% of the one-hour objective for ammonia (NH_3).
- 15% of the one-hour objective for carbon monoxide (CO).
- 50% of the one-hour objective for hydrogen sulphide (H_2S).
- 5% of the one-hour objective for nitrogen dioxide (NO_2).
- 44% of the one-hour objective for ozone (O_3).
- 1% of the one-hour objective for sulphur dioxide (SO_2).

Table 1: Summary of monitoring results and One-Hour Ambient Objectives for the Girouxville CFO Survey.

Pollutant		Units	Measured Concentrations			Alberta Ambient One Hour Objective	# Objective Exceedances
			Minimum	Maximum	Median		
Ammonia (NH_3)		ppm	bd	0.210	0.009	2	0
Carbon Monoxide (CO)		ppm	bd	2.0	0.2	13	0
Hydrocarbons	Methane (CH_4)	ppm	2.0	2.6	2.1	n/a	n/a
	Reactive Hydrocarbons (RHC)	ppm	bd	0.1	bd	n/a	n/a
	Total Hydrocarbons (THC)	ppm	2.0	2.6	2.2	n/a	n/a
Hydrogen Sulphide (H_2S)		ppm	bd	0.005	bd	0.010	0
Oxides of Nitrogen	Nitric Oxide (NO)	ppm	bd	0.007	0.001	n/a	n/a
	Nitrogen Dioxide (NO_2)	ppm	0.001	0.003	0.001	0.212	0
	Total Oxides of Nitrogen (NO_x)	ppm	0.001	0.010	0.002	n/a	n/a
Ozone (O_3)		ppm	0.020	0.036	0.027	0.082	0
Particulate Matter*	PM_{10}	$\mu g/m^3$	1	53	8	n/a	n/a
	$PM_{2.5}$	$\mu g/m^3$	bd	4	1	n/a	n/a
	TSP	$\mu g/m^3$	2	111	14	n/a	n/a
Polycyclic Aromatic Hydrocarbons (PAH)		ng/m^3	bd	10	bd	n/a	n/a
Sulphur Dioxide (SO_2)		ppm	bd	0.002	0.001	0.172	0
Total Reduced Sulphur (TRS)		ppm	bd	0.004	0.001	n/a	n/a

Note: ppm-parts per million
bd - below instrument detection limit
$\mu g/m^3$ - micrograms per cubic metre of air
ng/m^3 - nanograms per cubic metre of air

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2) **Permanent Ambient Monitoring Stations:** The permanent Beaverlodge Ambient Monitoring Station measured similar concentrations of Ozone, Sulphur Dioxide, Nitric Oxide, Nitrogen Dioxide, and Oxides of Nitrogen as those measured by the MAML in the Girouxville area.

3) **Other CFO Surveys:** Alberta Environment conducted a mobile ambient air quality survey in the Counties of Lethbridge and Warner for a period of ten days over four seasons between September 1998 and July 1999[2]. Similar to the Girouxville CFO Survey, the Lethbridge survey was in response to public complaints about odourous emissions from livestock feeding operations. The Lethbridge survey found that concentrations of all compounds monitored during the survey were within Alberta's Ambient Air Quality Objectives (AAAQOs) with two exceptions. Both exceptions involved hydrogen sulphide; in each case the levels were recorded close to the source of odour. Similarly, the Fall 2004 Girouxville CFO survey found the highest hydrogen sulphide concentrations at the fence-line of an CFO property. However, the AAAQO for hydrogen sulphide was *not* exceeded in this case.

4) **CFO Odour Detection:** Scientific research has identified over 150 odorous compounds in air emissions from confined feeding operations [1,4,5]. Individual compounds contribute to the overall odour character either by making the odours more offensive, easier to detect, or harder to measure[3]. Unfortunately, there are few accepted instrument-based methods that can measure an odour response in the same way as the human nose[1].

   When operated in unison, the suite of analyzers onboard the MAML provide a snap-shop of air quality in time and space; the MAML is limited in its ability to qualify and quantify odour sources. With respect to odour, this survey is only capable of determining whether specific pollutants, some of which are odorous (namely ammonia and hydrogen sulphide), are present at concentrations that are above or below their respective AAAQOs or odour thresholds.

5) **Odour Threshold:** For known odourous compounds that the MAML is able to detect, only hydrogen sulphide was found to be above its odour threshold[6,7]; these elevated concentrations were found at the fence line of a CFO. Although trace odours may be present further downwind near residential locations, hydrogen sulphide concentrations were found to be negligible near homesteads. There may be other odourous airborne compounds emitted by the CFOs that the MAML is not designed to detect, or are below detection limits of the available analyzers.

Monitoring Locations

The sites monitored were south of Girouxville at the locations provided in Figure 1 and Table 2.

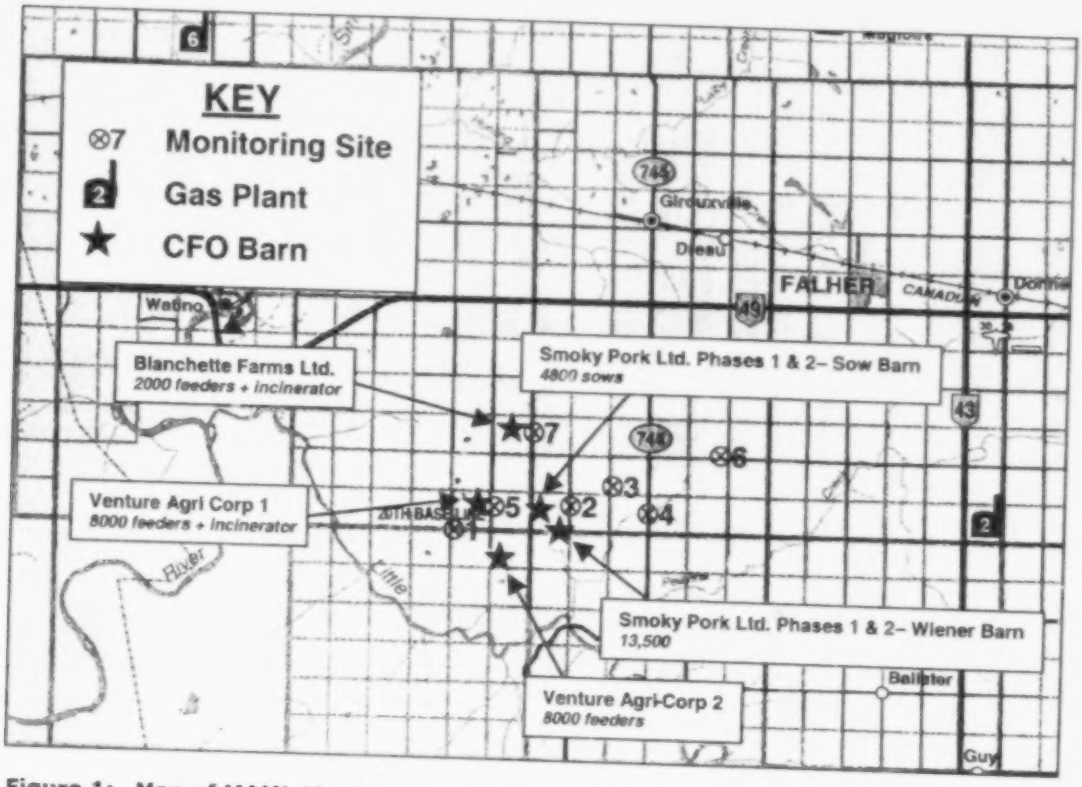

Figure 1: Map of MAML Monitoring Locations.
Adapted from: AGAPE Publishing. 1995, *Canadian Oilfield Gas Plant Atlas*, APC, Edmonton.

Table 2: Monitoring Locations, Frequency, and Associated Site Numbers

SITE	DESCRIPTION	MONITORING DATES
1	Township Road 770 west of Range Road 231 (background)	Nov 29, Nov 30
2	Range Road 225 between Township Roads 770 and 772	Nov 29, Nov 30 (twice), Dec 1
3	Range Road 224 between Township Roads 770 and 772	Nov 29
4	Highway 774 between Township Roads and 772	Nov 29, Nov 30
5	Range Road 231 beside Venture Agri-Corp 1	Nov 30 (twice), Dec 1
6	Range Road 221 south of Township Road 772	Nov 30 (twice), Dec 1
7	Range Road 230 beside Blanchette Farms Ltd.	Dec 1 (twice)

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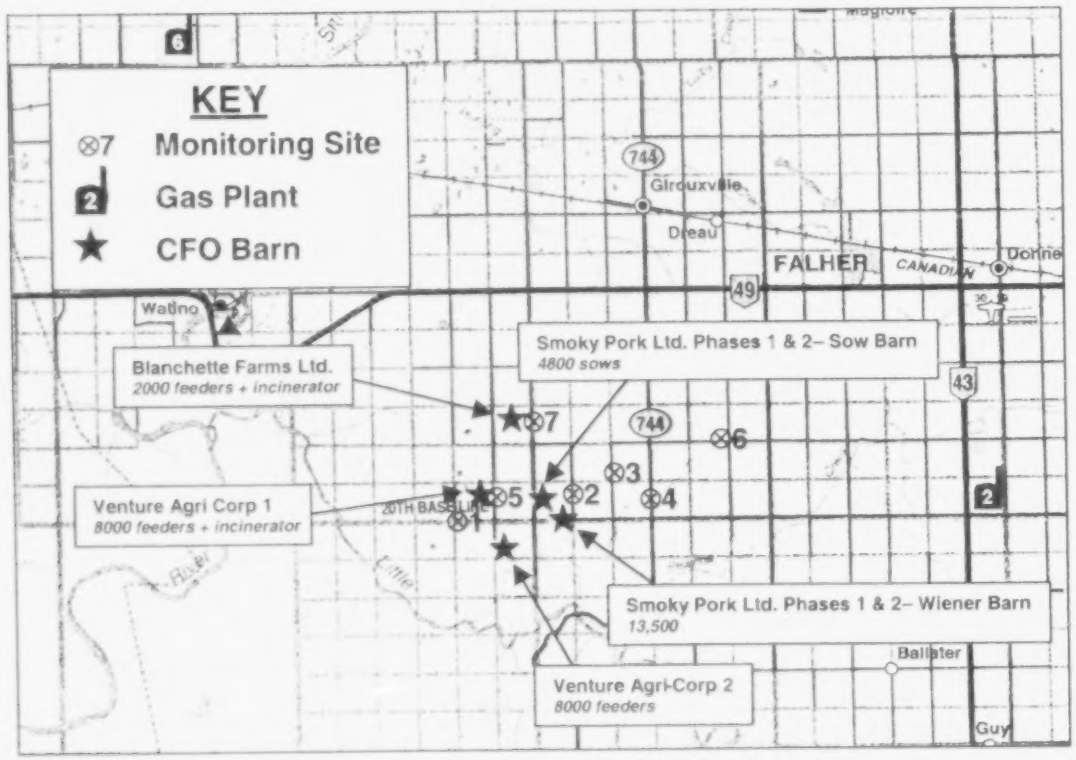

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Monitoring Site Photographs

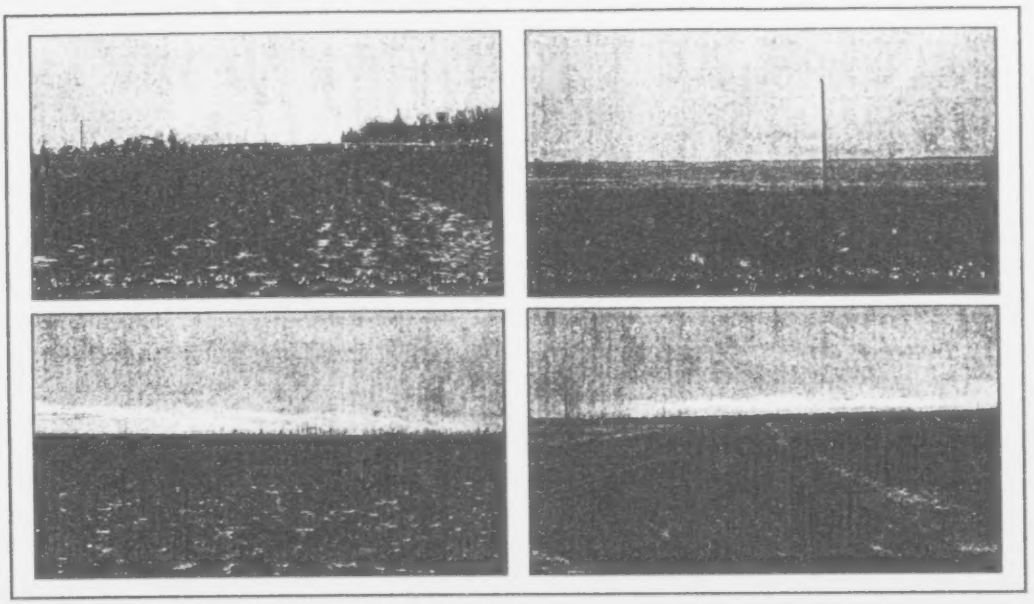

Figure 2: Clockwise from upper left – north, east, south, and west views from MAML monitoring site 4; landscapes shown here are typical for the Girouxville area.

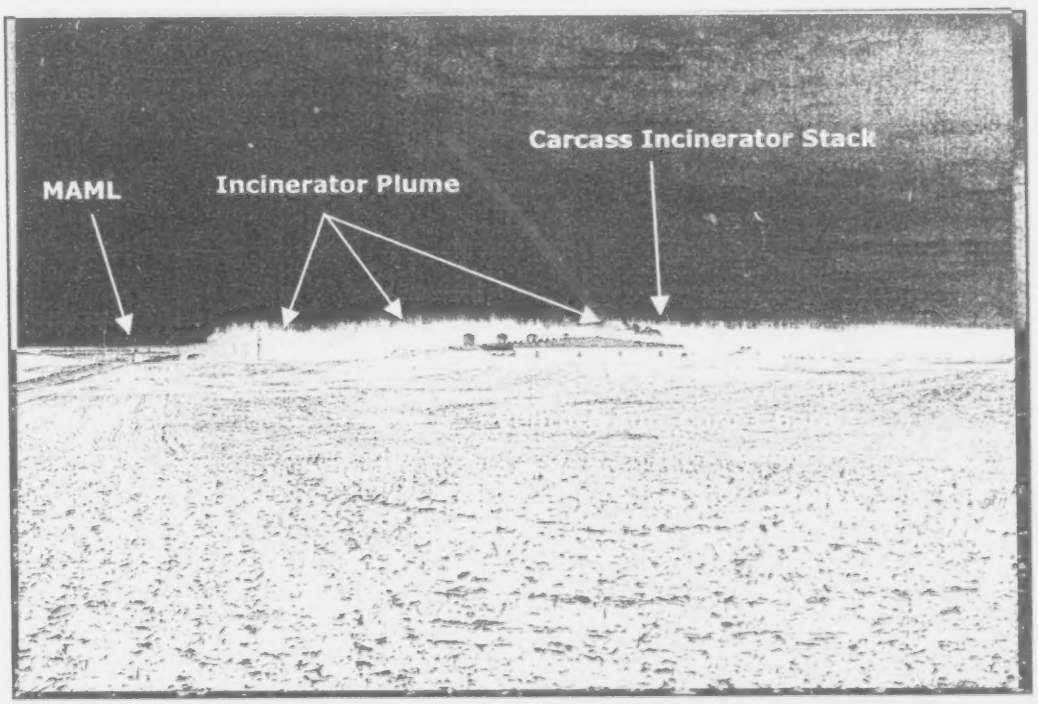

Figure 3: MAML monitoring at site 5 (the carcass incinerator is active).

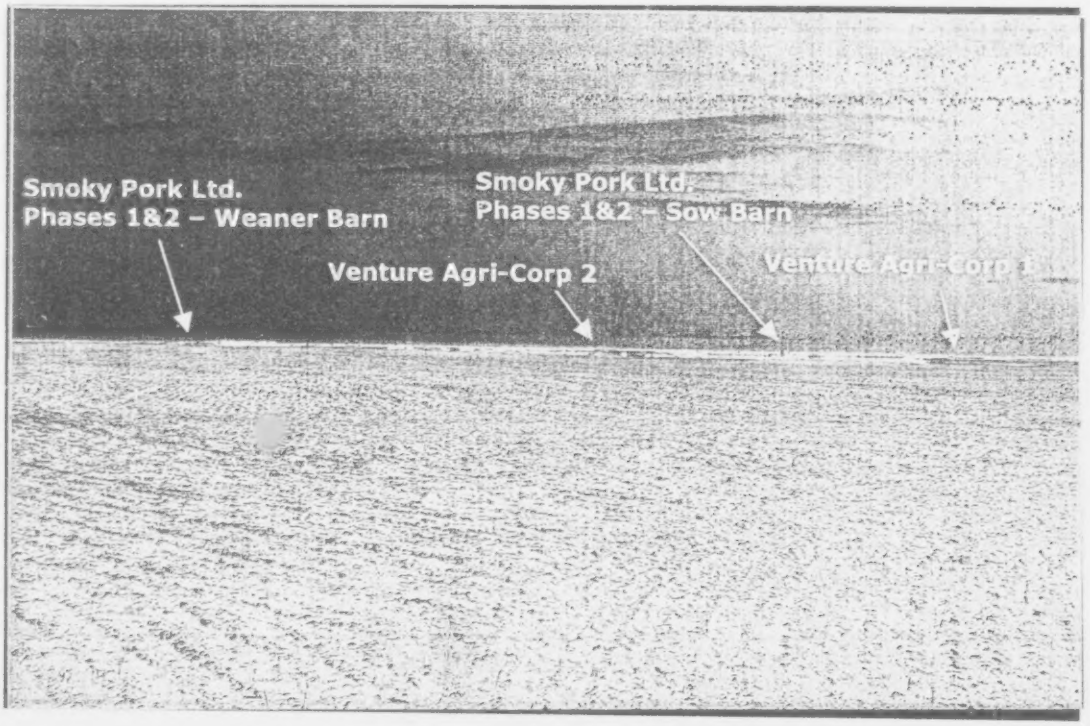

Figure 4: Southwest view from MAML at monitoring site 2.

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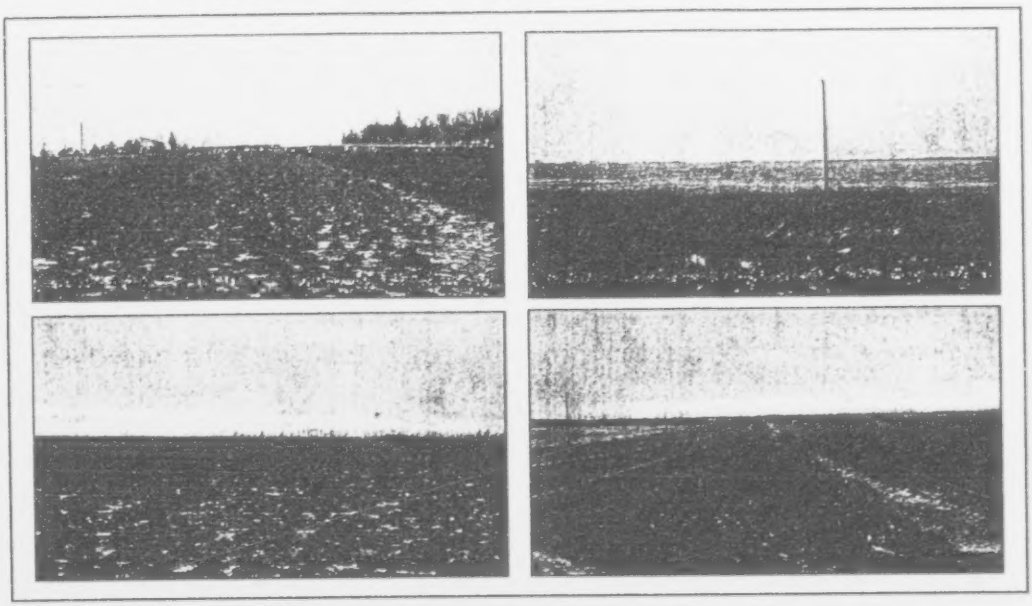

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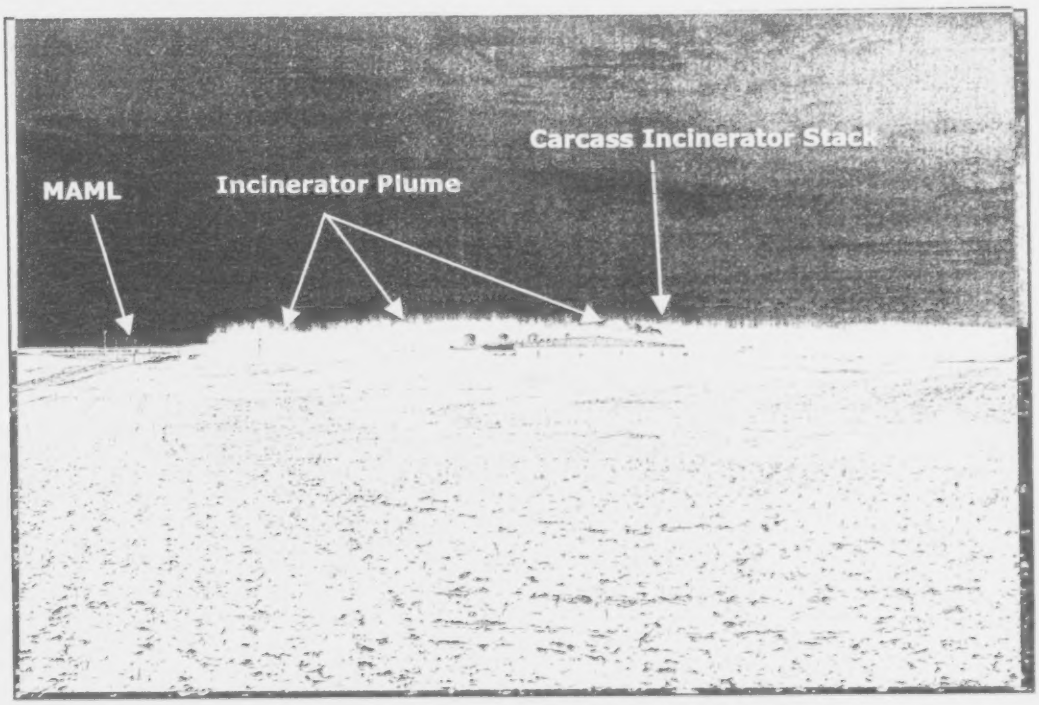

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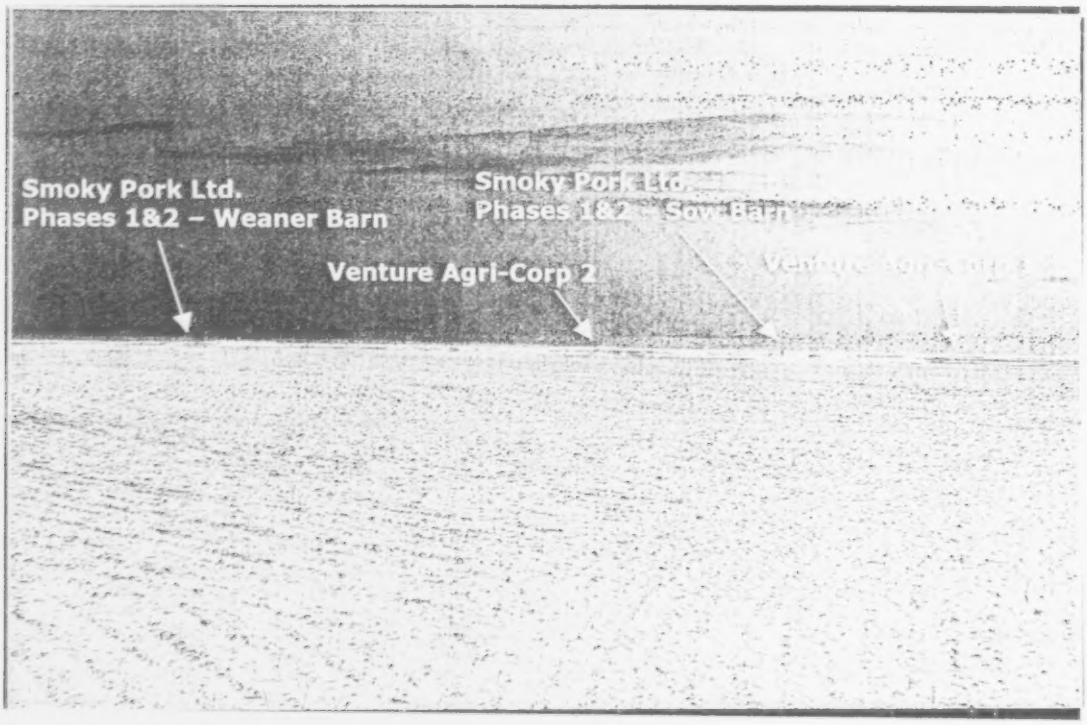

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Wind Measurements

The MAML consistently recorded a westerly wind direction during the survey. Therefore, the ideal monitoring locations for determining the concentration of pollutants from the CFOs were east of the barns. Favourable ground conditions allowed the MAML to locate several monitoring sites adjacent to the easily accessible Range Roads east (downwind) of the CFOs. Some of these locations were also in the vicinity of homesteads where CFO odours were a public concern. In some cases, road access allowed the MAML to monitor pollutant concentrations at the fence-line of CFO properties.

The average wind speeds on November 29, 30 and December 1 were 10.9km/h, 8.9km/h, and 10.6km/h respectively. These wind speeds are relatively light and hinder atmospheric dispersion of pollutants.

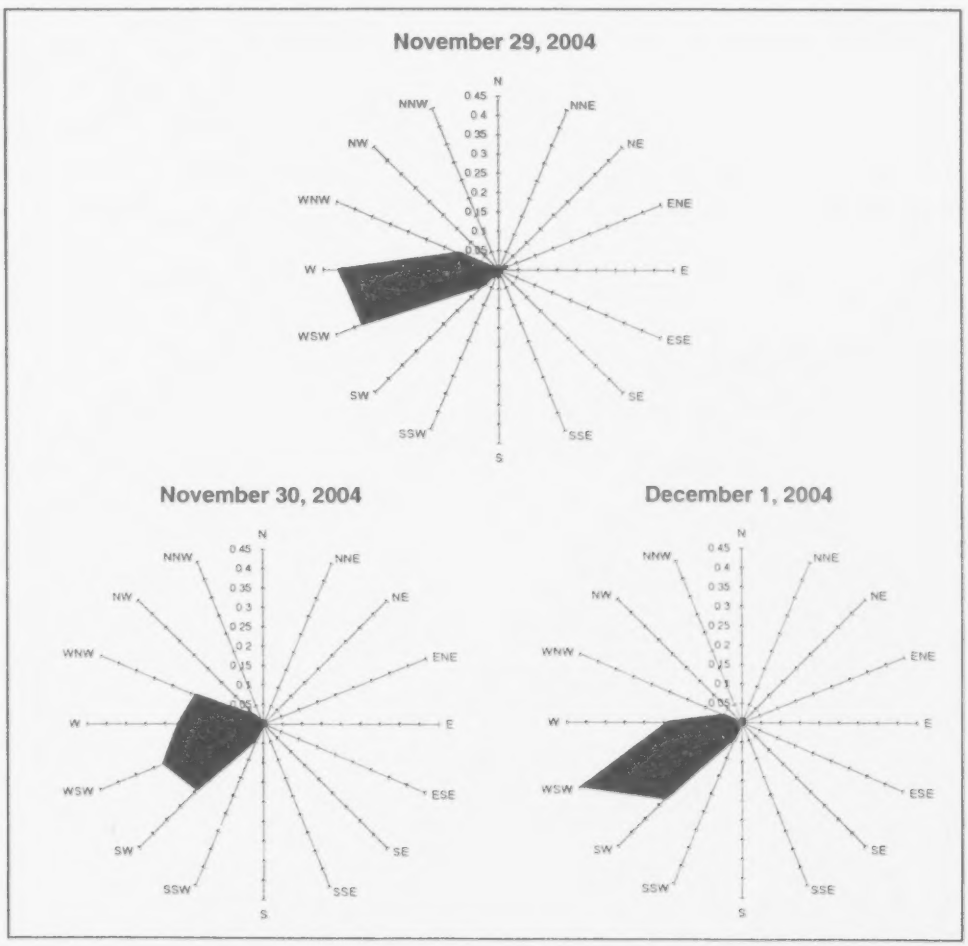

Figure 5: Windrose plots for the Girouxville CFO Fall 2004 Survey

Alberta's Ambient Air Quality Objectives (AAAQOs)

Alberta's Ambient Air Quality Objectives are established under Section 14 of the Environmental Protection and Enhancement Act (EPEA). EPEA provides for the development of objectives and ambient environmental quality objectives for Alberta.

The Ambient Air Quality Objectives are used for:

- reporting on the state of the atmospheric environment in Alberta.
- reporting to Albertans on the quality of air through an air quality index (AQI).
- establishing approval conditions for regulated industrial facilities.
- evaluating proposals to construct facilities that will have air emissions.
- guiding special ambient air quality surveys.
- assessing compliance near major industrial air emission sources.

Some of Alberta's Ambient Air Quality Objectives are based on odour perception. This is the case for hydrogen sulphide, ammonia and nitrogen dioxide. For these chemicals, people are likely to detect an odour at concentrations well below levels that may affect human health. Alberta's Ambient Air Quality Objectives for one-hour concentrations of parameters monitored by the MAML and the basis for the objective are listed in Table 2.

Table 3: Alberta's Ambient Air Quality Objectives for Parameters Monitored by the MAML.

AIR QUALITY PARAMETER	ONE-HOUR OBJECTIVE (PPM*)	BASIS FOR OBJECTIVE
Ammonia	2	odour perception
Carbon monoxide	13	oxygen carrying capacity of blood
Hydrogen sulphide	0.010	odour perception
Nitrogen dioxide	0.212	odour perception
Ozone	0.082	reduction of lung function and vegetation
Sulphur dioxide	0.172	pulmonary function

Note: *Parts per million by volume.

Air Quality Monitoring Using the MAML (Mobile Air Monitoring Laboratory)

The MAML is a 27-foot (8.2 m) vehicle specially designed and equipped to measure air quality (Figure 6). The MAML monitoring provides a "snapshot" in time and space of the air quality at the location monitored. It houses a variety of instruments that continuously sample air at specified times or distance intervals. The MAML is equipped with:

- a dual computer system custom-programmed to accept and record the measurement of air samples from each analyzer.
- a GPS (Global Positioning System) that identifies the MAML's location as it moves around Alberta.
- an exhaust purifying system that minimizes emissions from the vehicle.
- two on-board generators that are also equipped with exhaust scrubbers.

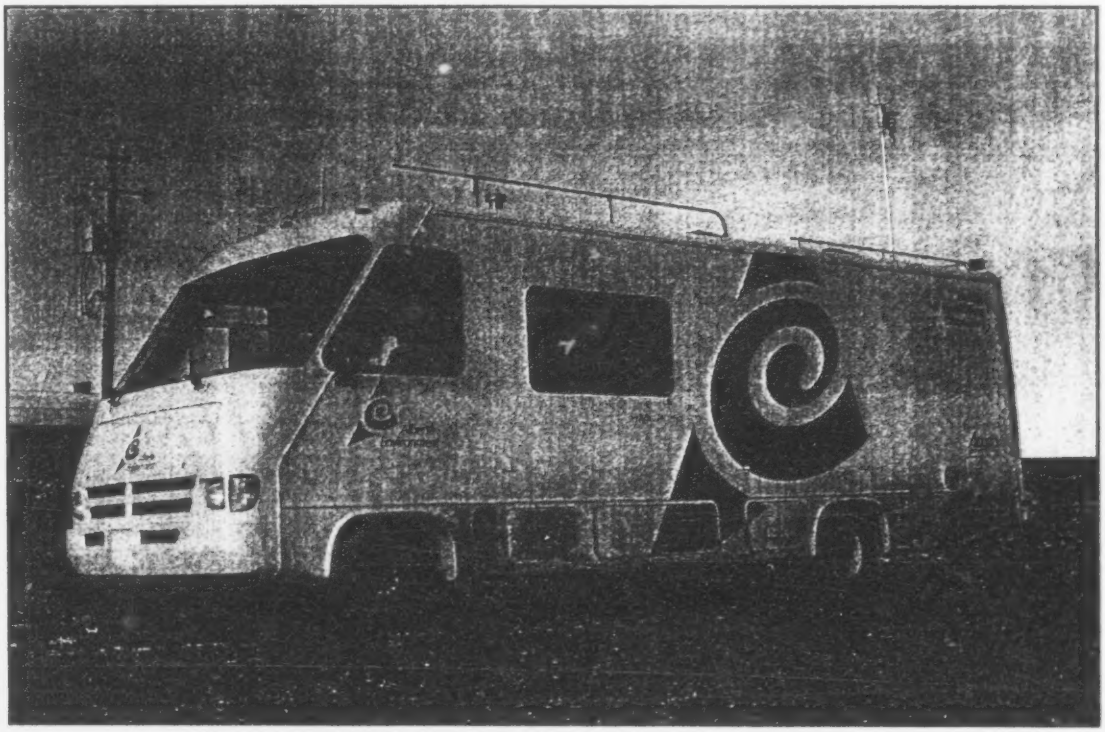

Figure 6: Alberta Environment's MAML monitoring east of Venture Agri-Corp 1 CFO Barn (low profile structure in background) near Girouxville.

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Appendices

Appendix A: Summary of parameters monitored during the Girouxville CFO Survey; also included is the instrument operating range.

Table 4: Parameters monitored for the Girouxville CFO Survey and instrument operating range.

Parameter Measured		Operating Range	
		Lower Detection Limit*	**Maximum Detection Limit****
Ammonia (NH_3)		0.001 ppm	5 ppm
Carbon Monoxide (CO)		0.1 ppm	50 ppm
Hydrocarbons	Methane (CH_4)	0.005 ppm	10 ppm
	Reactive Hydrocarbons (RHC)	0.005 ppm	20 ppm
	Total Hydrocarbons (THC)	0.005 ppm	20 ppm
Hydrogen Sulphide (H_2S)		0.0006 ppm	1 ppm
Oxides of Nitrogen	Nitric Oxide (NO)	0.001 ppm	1 ppm
	Nitrogen Dioxide (NO_2)	0.001 ppm	1 ppm
	Total Oxides of Nitrogen (NO_x)	0.001 ppm	1 ppm
Ozone (O_3)		0.001 ppm	0.5 ppm
Particulates	Inhalable Particulates (PM_{10})	1 $\mu g/m^3$	1.0 g/m^3
	Respirable Particulates ($PM_{2.5}$)	1 $\mu g/m^3$	1.0 g/m^3
	Total Suspended Particulates (TSP)	1 $\mu g/m^3$	1.0 g/m^3
Polycyclic Aromatic Hydrocarbons (PAHs)		3 ng/m^3	1000 ng/m^3
Sulphur Dioxide (SO_2)		0.0006 ppm	1 ppm
Total Reduced Sulphur (TRS)		0.0006 ppm	1 ppm
Relative Humidity (RH)		0 %	100 %
Temperature (Temp)		-40 °C	50 °C
Wind Direction (WDR)		0 degrees	360 degrees
Wind Speed (WSP)		0 km/h	200 km/h

Note: ppb = parts per billion ppm = parts per million ng/m^3 = nanograms per cubic metre
$\mu g/m^3$ = micrograms per cubic metre g/m^3 = grams per cubic metre
km/h = kilometres per hour °C = degrees Celsius
% = per cent

* The *lower* ***detection limit*** indicates the *minimum* amount of pollutant the instrument can measure.

** The ***maximum detection limit*** indicates the *maximum* amount of pollutant the instrument can detect. This limit is set to provide the optimum precision over that range. The upper limit can be raised, however, precision at the lower levels (where most levels are monitored) is then compromised.

Appendix B: *Comparison of concentrations measured during the Girouxville CFO survey to the Beaverlodge Station and MAML readings during the 1998-1999 Lethbridge CFO Survey.*

Table 5: Minimum, Maximum, and Median 1-hour ambient air concentrations recorded by the MAML during the Fall 2004 Girouxville CFO Survey, at the Beaverlodge Station, and on the MAML's 1998-99 Lethbridge Area CFO Air Quality Survey.

Monitoring Location / Event	Summary Statistic	CO (ppm)	O_3 (ppm)	THC (ppm)	CH_4 (ppm)	RHC (ppm)	SO_2 (ppm)	NO (ppm)	NO_2 (ppm)	NO_x (ppm)	NH_3 (ppm)	TRS (ppm)	H_2S (ppm)	TSP (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (ng/m³)	PAH ng/m³
Lethbridge ILO Survey Sept and Feb 1999	min	bd	0.014	1.9	1.6	0.1	bd	bd	bd	bd	0.008	bd	bd	2	1	bd	bd
	max	1.2	0.051	9.5	bd	1.6	0.003	0.007	0.013	0.015	0.600	0.041	0.042	442	298	32	6
	median	0.3	0.045	2.2	1.8	0.2	0.001	0.002	0.002	0.004	0.075	0.001	0.001	59	39	4	2
Beaverlodge Station Nov 29, 30 and Dec 1, 2004	min	na	0.023	na	na	na	bd	bd	0.001	0.001	na	na	na	na	na	na	na
	max	na	0.037	na	na	na	0.0008	0.001	0.007	0.007	na	na	na	na	na	na	na
	median	na	0.031	na	na	na	0.0001	bd	0.002	0.002	na	na	na	na	na	na	na
Girouxville ILO Survey Nov 29, 30 and Dec 1, 2004	min	bd	0.020	2.0	2.0	bd	bd	bd	0.001	0.001	bd	bd	bd	< 2	1	bd	bd
	max	2.0	0.036	2.6	2.6	0.1	0.002	0.007	0.003	0.010	0.210	0.004	0.005	111	53	4	10
	median	0.2	0.027	2.2	2.1	bd	0.001	0.001	0.001	0.002	0.009	0.001	bd	14	8	1	bd

Note: na - not available at monitoring station
bd - below instrument detection limit

Appendix C: *Weather conditions and operator observations made during the Girouxville survey.*

Table 6: Weather conditions and operator remarks.

Date	Monitoring Location	Time (MST)	Temp. °C	Relative Humidity %	Wind Speed km/h	Wind Dir.	Operator's Remarks
29-Nov-04	1	15:05 to 16:10	4.5	54.3	13.3	WSW	background site
	2	16:28 to 17:31	2.9	64.7	12.1	W	1 mile downwind of Sow barn
	3	17:43 to 18:48	1.7	70.6	8.4	WSW	some odours from hog barns in general
	4	19:01 to 20:04	1.6	72.8	9.8	W	west wind at approx 10kph
30-Nov-04	4	09:46 to 10:49	1.0	74.1	8.8	WSW	visit from FOUL member
	5	11:03 to 12:06	1.9	65.3	13.1	W	
	2	12:26 to 13:26	2.2	66.8	12.4	W	Downwind from sow barns; incinerator odour
	2	13:26 to 14:26	2.6	66.0	11.1	WNW	wind has shifted a bit more northerly
	5	14:41 to 15:41	2.6	63.4	9.6	W	incinerator is active
	1	15:51 to 16:52	1.7	66.0	10.4	WSW	
	6	17:28 to 18:28	-2.1	84.6	6.5	SW	very light WSW wind
	6	18:28 to 19:28	-1.5	86.7	6.8	SSW	
1-Dec-04	5	09:04 to 10:06	0.0	83.6	8.9	W	truck loading dock & one idling; strong odours incinerator is active
	2	10:31 to 11:35	1.3	80.2	8.4	SW	variable odours - light to strong barn and incinerator odour
	7	11:45 to 12:48	3.2	69.7	11.4	WSW	strong odours from barns incinerator is not active
	6	13:06 to 14:09	4.3	68.1	10.2	SW	very faint and fleeting odours
	7	14:26 to 15:27	3.4	71.8	14.3	WSW	strong odours evident again

*Weather conditions based on observations at monitoring site. Units are: temperature [°C], relative humidity [%], wind speed [km/h], wind direction [degrees]

Appendices

Appendix A: Summary of parameters monitored during the Girouxville CFO Survey; also included is the instrument operating range.

Table 4: Parameters monitored for the Girouxville CFO Survey and instrument operating range.

Parameter Measured		Operating Range	
		Lower Detection Limit*	**Maximum Detection Limit****
Ammonia (NH_3)		0.001 ppm	5 ppm
Carbon Monoxide (CO)		0.1 ppm	50 ppm
Hydrocarbons	Methane (CH_4)	0.005 ppm	10 ppm
	Reactive Hydrocarbons (RHC)	0.005 ppm	20 ppm
	Total Hydrocarbons (THC)	0.005 ppm	20 ppm
Hydrogen Sulphide (H_2S)		0.0006 ppm	1 ppm
Oxides of Nitrogen	Nitric Oxide (NO)	0.001 ppm	1 ppm
	Nitrogen Dioxide (NO_2)	0.001 ppm	1 ppm
	Total Oxides of Nitrogen (NO_x)	0.001 ppm	1 ppm
Ozone (O_3)		0.001 ppm	0.5 ppm
Particulates	Inhalable Particulates (PM_{10})	1 $\mu g/m^3$	1.0 g/m^3
	Respirable Particulates ($PM_{2.5}$)	1 $\mu g/m^3$	1.0 g/m^3
	Total Suspended Particulates (TSP)	1 $\mu g/m^3$	1.0 g/m^3
Polycyclic Aromatic Hydrocarbons (PAHs)		3 ng/m^3	1000 ng/m^3
Sulphur Dioxide (SO_2)		0.0006 ppm	1 ppm
Total Reduced Sulphur (TRS)		0.0006 ppm	1 ppm
Relative Humidity (RH)		0 %	100 %
Temperature (Temp)		-40 °C	50 °C
Wind Direction (WDR)		0 degrees	360 degrees
Wind Speed (WSP)		0 km/h	200 km/h

Note: ppb = parts per billion ppm = parts per million ng/m^3 = nanograms per cubic metre
$\mu g/m^3$ = micrograms per cubic metre g/m^3 = grams per cubic metre
km/h = kilometres per hour °C = degrees Celsius
% = per cent

* The *lower* ***detection limit*** indicates the *minimum* amount of pollutant the instrument can measure.

** The ***maximum detection limit*** indicates the *maximum* amount of pollutant the instrument can detect. This limit is set to provide the optimum precision over that range. The upper limit can be raised, however, precision at the lower levels (where most levels are monitored) is then compromised.

Appendix B: *Comparison of concentrations measured during the Girouxville CFO survey to the Beaverlodge Station and MAML readings during the 1998-1999 Lethbridge CFO Survey.*

Table 5: Minimum, Maximum, and Median 1-hour ambient air concentrations recorded by the MAML during the Fall 2004 Girouxville CFO Survey, at the Beaverlodge Station, and on the MAML's 1998-99 Lethbridge Area CFO Air Quality Survey.

Monitoring Location / Event	Summary Statistic	CO (ppm)	O_3 (ppm)	THC (ppm)	CH_4 (ppm)	RHC (ppm)	SO_2 (ppm)	NO (ppm)	NO_2 (ppm)	NO_x (ppm)	NH_3 (ppm)	TRS (ppm)	H_2S (ppm)	TSP ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	PAH ng/m^3
Lethbridge ILO Survey Sept and Feb 1999	min	bd	0.014	1.9	1.5	0.1	bd	bd	bd	bd	0.008	bd	bd	2	1	bd	bd
	max	1.2	0.051	9.5	bd	1.6	0.003	0.007	0.013	0.018	0.600	0.041	0.042	442	298	32	6
	median	0.3	0.045	2.2	1.8	0.2	0.001	0.002	0.002	0.004	0.075	0.001	0.001	50	30	4	2
Beaverlodge Station Nov 29, 30 and Dec 1, 2004	min	na	0.022	na	na	na	bd	bd	0.001	0.001	na	na	na	na	na	na	na
	max	na	0.037	na	na	na	0.0009	0.001	0.007	0.007	na	na	na	na	na	na	na
	median	na	0.031	na	na	na	0.0001	bd	0.002	0.002	na	na	na	na	na	na	na
Girouxville ILO Survey Nov 29, 30 and Dec 1, 2004	min	bd	0.020	2.0	2.0	bd	bd	bd	0.001	0.001	bd	bd	bd	< 2	1	bd	bd
	max	2.0	0.036	2.6	2.6	0.1	0.002	0.007	0.003	0.010	0.210	0.004	0.005	111	53	4	10
	median	0.2	0.027	2.2	2.1	bd	0.001	0.001	0.001	0.002	0.009	0.001	bd	14	8	1	bd

Note: na - not available at monitoring station
bd - below instrument detection limit

Appendix C: *Weather conditions and operator observations made during the Girouxville survey.*

Table 6: Weather conditions and operator remarks.

Date	Monitoring Location	Time (MST)	Temp. °C	Relative Humidity %	Wind Speed km/h	Wind Dir.	Operator's Remarks
29-Nov-04	1	15:05 to 16:10	4.5	54.3	13.3	WSW	background site
	2	16:28 to 17:31	2.9	64.7	12.1	W	1 mile downwind of Sow barn
	3	17:43 to 18:48	1.7	70.6	8.4	WSW	some odours from hog barns in general
	4	19:01 to 20:04	1.6	72.8	9.8	W	west wind at approx 10kph
30-Nov-04	4	09:46 to 10:49	1.0	74.1	8.8	WSW	visit from FOUL member
	5	11:03 to 12:06	1.9	65.3	13.1	W	
	2	12:26 to 13:26	2.2	66.8	12.4	W	Downwind from sow barns; incinerator odour
	2	13:26 to 14:26	2.6	66.0	11.1	WNW	wind has shifted a bit more northerly
	5	14:41 to 15:41	2.6	63.4	9.6	W	incinerator is active
	1	15:51 to 16:52	1.7	66.0	10.4	WSW	
	6	17:28 to 18:28	-2.1	84.6	6.5	SW	very light WSW wind
	6	18:28 to 19:28	-1.5	86.7	6.8	SSW	
1-Dec-04	5	09:04 to 10:06	0.0	83.6	8.9	W	truck loading dock & one idling; strong odours incinerator is active
	2	10:31 to 11:35	1.3	80.2	8.4	SW	variable odours - light to strong barn and incinerator odour
	7	11:45 to 12:48	3.2	69.7	11.4	WSW	strong odours from barns incinerator is not active
	6	13:06 to 14:09	4.3	68.1	10.2	SW	very faint and fleeting odours
	7	14:26 to 15:27	3.4	71.8	14.3	WSW	strong odours evident again

*Weather conditions based on observations at monitoring site. Units are: temperature [°C], relative humidity [%], wind speed [km/h], wind direction [degrees]

Appendix D: Summary of one-hour average ambient concentrations at each MAML monitoring site during the Girouxville CFO Survey, November 29, 30 and December 1 2004.

Table 7: Summary of one-hour average concentrations.

Site 1: Township Road 770 west of Range Road 231

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	15:05 to 16:10	2.0	0.036	2.3	2.3	bd	0.001	bd	0.001	0.001	0.001	bd	0.001	2	1	bd	bd
Nov 30/04	15:51 to 16:52	0.2	0.031	2.1	2.0	bd	0.001	0.001	0.001	0.002	0.010	0.003	bd	3	2	bd	bd

Site 2: Range Road 225 between Township Roads 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	16:28 to 17:31	1.6	0.029	2.4	2.5	bd	bd	bd	0.001	0.002	0.001	0.001	bd	19	10	1	bd
Nov 30/04	12:26 to 13:26	0.1	0.027	2.1	2.1	bd	0.001	0.003	0.001	0.004	0.009	0.003	0.001	12	5	bd	bd
Nov 30/04	13:26 to 14:26	0.1	0.026	2.0	2.0	bd	0.001	0.005	0.001	0.002	0.003	0.001	bd	73	32	2	bd
Dec 1/04	10:31 to 11:35	0.2	0.021	2.3	2.3	bd	0.001	0.002	0.002	0.004	0.024	0.001	0.001	8	5	bd	bd

Site 3: Range Road 224 between Township Road 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	17:43 to 18:48	1.5	0.030	2.4	2.5	bd	bd	bd	0.001	0.002	bd	0.001	bd	5	3	1	bd

Site 4: Highway 774 between Township Road 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	19:01 to 20:04	1.4	0.028	2.3	2.4	bd	bd	bd	0.001	0.002	0.001	bd	bd	2	1	bd	bd
Nov 30/04	09:46 to 10:49	bd	0.026	2.0	2.1	bd	bd	0.002	0.001	0.003	bd	0.001	bd	29	16	1	bd

Site 5: Range Road 231 beside Feeder Barn # 1

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 30/04	11:03 to 12:06	bd	0.031	2.2	2.3	bd	0.001	0.003	0.001	0.004	0.036	0.002	0.001	20	11	2	bd
Nov 30/04	14:41 to 15:41	0.3	0.030	2.4	2.4	0.1	0.001	0.003	0.001	0.004	0.099	0.004	0.005	51	25	3	9.8
Dec 1/04	09:04 to 10:06	0.3	0.024	2.6	2.6	0.1	0.001	0.007	0.003	0.010	0.210	0.002	0.005	111	53	4	8.2

Site 6: Range Road 221 south of Township Road 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 30/04	17:28 to 18:28	0.2	0.021	2.1	2.1	bd	bd	0.001	0.001	0.002	0.002	0.002	bd	19	12	1	bd
Nov 30/04	18:28 to 19:28	0.2	0.020	2.1	2.1	bd	bd	0.001	0.001	0.001	bd	0.002	bd	4	3	1	bd
Dec 1/04	13:06 to 14:09	0.1	0.027	2.1	2.1	bd	0.002	bd	0.001	0.001	0.016	bd	bd	7	4	bd	bd

Site 7: Range Road 230 beside Blanchette Farms Ltd.

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Dec 1/04	11:45 to 12:48	0.2	0.027	2.1	2.1	bd	0.002	0.002	0.001	0.004	0.112	0.001	0.001	36	17	1	bd
Dec 1/04	14:26 to 15:27	0.1	0.026	2.2	2.1	bd	0.002	bd	0.001	0.001	0.074	bd	0.001	14	8	1	bd

Alberta's Ambient Air Quality Objectives

CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
13.0	0.082	n/a	n/a	n/a	0.172	n/a	0.212	n/a	2.0	n/a	0.010	n/a	n/a	n/a	n/a

CO-carbon monoxide RHC-reactive hydrocarbons NOX-total oxides of nitrogen TSP-total suspended particulate
O3-ozone SO2-sulpher dioxide NH3-ammonia PM10-inhalable particulates
THC-total hydrocarbons NO-nitric oxide TRS-total reduced sulpher PM2.5-respirable particulates
CH4-Methane NO2-nitrogen dioxide H2S-hydrogen sulphide bd-below instrument detection limit

Appendix D: Summary of one-hour average ambient concentrations at each MAML monitoring site during the Girouxville CFO Survey, November 29, 30 and December 1 2004.

Table 7: Summary of one-hour average concentrations.

Site 1: Township Road 770 west of Range Road 231

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	15:05 to 16:10	2.0	0.036	2.3	2.3	bd	0.001	bd	0.001	0.001	0.001	bd	0.001	2	1	bd	bd
Nov 30/04	15:51 to 16:52	0.2	0.031	2.1	2.0	bd	0.001	0.001	0.001	0.002	0.010	0.003	bd	3	2	bd	bd

Site 2: Range Road 225 between Township Roads 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	16:28 to 17:31	1.6	0.029	2.4	2.5	bd	bd	bd	0.001	0.002	0.001	0.001	bd	19	10	1	bd
Nov 30/04	12:26 to 13:26	0.1	0.027	2.1	2.1	bd	0.001	0.003	0.001	0.004	0.009	0.003	0.001	12	5	bd	bd
Nov 30/04	13:26 to 14:26	0.1	0.026	2.0	2.0	bd	0.001	0.005	0.001	0.002	0.003	0.001	bd	73	32	2	bd
Dec 1/04	10:31 to 11:35	0.2	0.021	2.3	2.3	bd	0.001	0.002	0.002	0.004	0.024	0.001	0.001	8	5	bd	bd

Site 3: Range Road 224 between Township Road 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	17:43 to 18:48	1.5	0.030	2.4	2.5	bd	bd	bd	0.001	0.002	bd	0.001	bd	5	3	1	bd

Site 4: Highway 774 between Township Road 770 and 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 29/04	19:01 to 20:04	1.4	0.028	2.3	2.4	bd	bd	bd	0.001	0.002	0.001	bd	bd	2	1	bd	bd
Nov 30/04	09:46 to 10:49	bd	0.026	2.0	2.1	bd	bd	0.002	0.001	0.003	bd	0.001	bd	29	16	1	bd

Site 5: Range Road 231 beside Feeder Barn # 1

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 30/04	11:03 to 12:06	bd	0.031	2.2	2.3	bd	0.001	0.003	0.001	0.004	0.036	0.002	0.001	20	11	2	bd
Nov 30/04	14:41 to 15:41	0.3	0.030	2.4	2.4	0.1	0.001	0.003	0.001	0.004	0.099	0.004	0.005	51	25	3	9.8
Dec 1/04	09:04 to 10:06	0.3	0.024	2.6	2.6	0.1	0.001	0.007	0.003	0.010	0.210	0.002	0.005	111	53	4	8.2

Site 6: Range Road 221 south of Township Road 772

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Nov 30/04	17:28 to 18:28	0.2	0.021	2.1	2.1	bd	bd	0.001	0.001	0.002	0.002	0.002	bd	19	12	1	bd
Nov 30/04	18:28 to 19:28	0.2	0.020	2.1	2.1	bd	bd	0.001	0.001	0.001	bd	0.002	bd	4	3	1	bd
Dec 1/04	13:06 to 14:09	0.1	0.027	2.1	2.1	bd	0.002	bd	0.001	0.001	0.016	bd	bd	7	4	bd	bd

Site 7: Range Road 230 beside Blanchette Farms Ltd.

Date	Start/End Times	CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
Dec 1/04	11:45 to 12:48	0.2	0.027	2.1	2.1	bd	0.002	0.002	0.001	0.004	0.112	0.001	0.001	36	17	1	bd
Dec 1/04	14:26 to 15:27	0.1	0.026	2.2	2.1	bd	0.002	bd	0.001	0.001	0.074	bd	0.001	14	8	1	bd

Alberta's Ambient Air Quality Objectives

CO PPM	O3 PPM	THC PPM	CH4 PPM	RHC PPM	SO2 PPM	NO PPM	NO2 PPM	NOx PPM	NH3 PPM	TRS PPM	H2S PPM	TSP µgr/m³	PM10 µgr/m³	PM 2.5 µgr/m³	PAH ngr/m3
13.0	0.082	n/a	n/a	n/a	0.172	n/a	0.212	n/a	2.0	n/a	0.010	n/a	n/a	n/a	n/a

CO-carbon monoxide
O3-ozone
THC-total hydrocarbons
CH4-Methane
RHC-reactive hydrocarbons
SO2-sulpher dioxide
NO-nitric oxide
NO2-nitrogen dioxide
NOX-total oxides of nitrogen
NH3-ammonia
TRS-total reduced sulpher
H2S-hydrogen sulphide
TSP-total suspended particulate
PM10-inhalable particulates
PM2.5-respirable particulates
bd-below instrument detection limit

Appendix E: Results for selected pollutants monitored during the Fall 2004 Girouxville Survey.

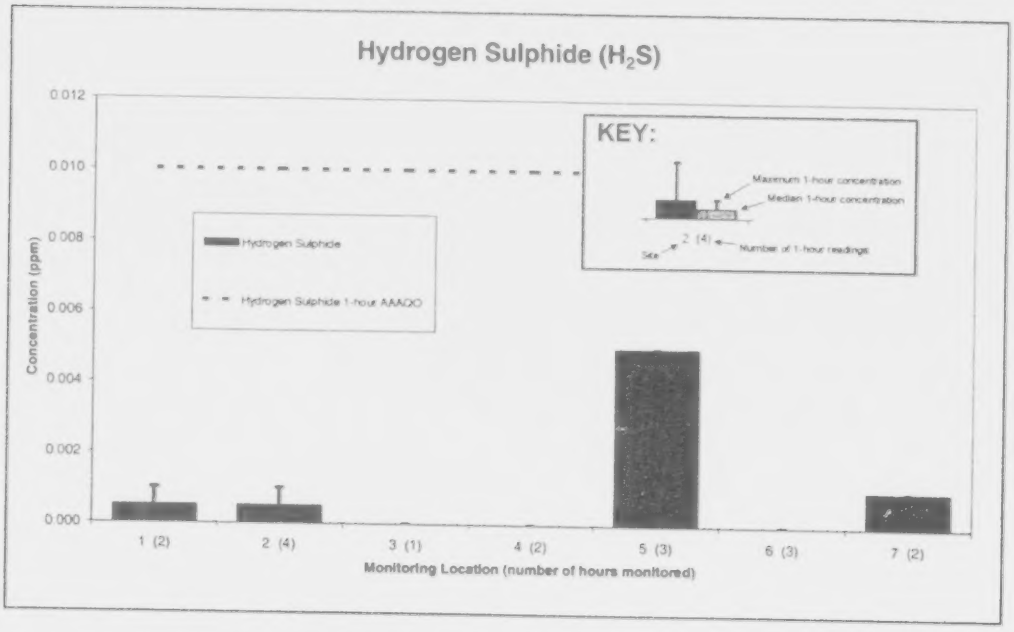

Figure 8: Hydrogen Sulphide monitoring data.

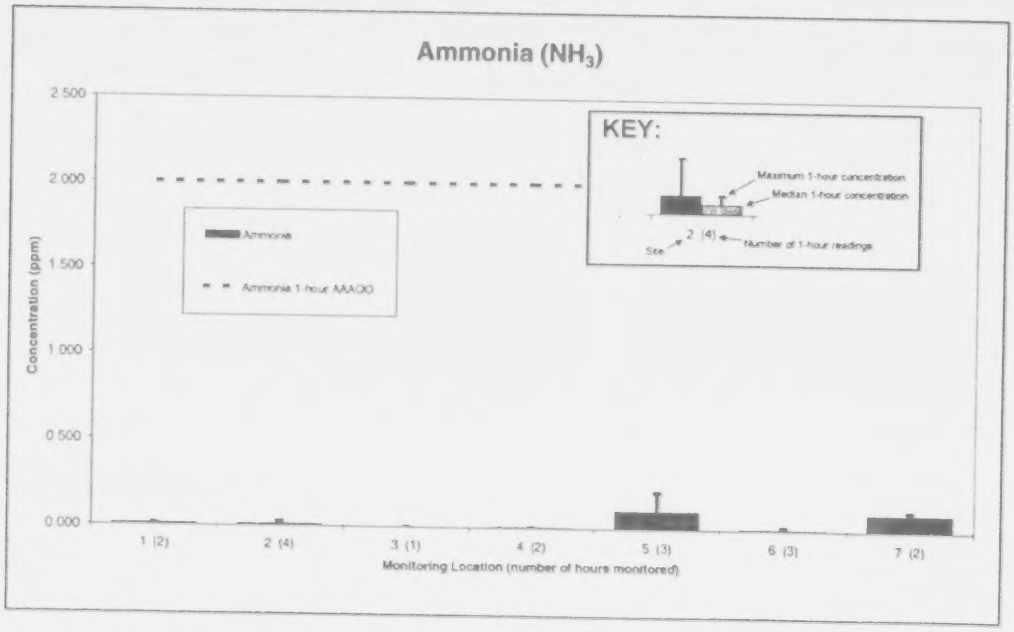

Figure 9: Ammonia monitoring data.